Basic Investigation of Quantitative Positron Autoradiography

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We have recently reported the basic principle, procedure and application of multiple label autoradiographic technique using positron emitting radionuclide tracers.[1,2] However, there still remains some problems before establishing the quantitative procedure of the positron autoradiography. The purpose of this study is to make further investigation of this newly developed technique, especially to solve the problems of standarization process of positron autoradiography.

Materials and Method

Gelatin of 0.2 gm was dissolved into 0.8 ml of distilled water at 60 ° C. After adding various dose of ^{18}F-solution, it was cooled at 4 ° C, then frozen in powdered dry ice. Frozen gelatin was cut 20 μm thickness in the cryostat. The sections were collected on the cover slips and dried at room temperature. Sections were then exposed to the X-ray film(KODAK NMC-1) for 6 hours in the spring loaded cassette. The residual gelatin mass was weighed and counted ^{18}F radioactivity. Six hours later, sections were removed from the X-ray film and ^{14}C autoradiographic standards (Amersham) were exposed to the same X-ray film for 7 days instead. Development of the X-ray film was followed by the densitometric measurement (SAKURA PDA-15) of ^{18}F sections and ^{14}C standards.

Results

The relationship between the density and the radioactivity of ^{14}C standards was linear as shown in Fig. 1, however, over the range of over 0.35 O.D. this linearity was lost. On the other hand, the linear relationship between the density and the radioactivity of ^{18}F was observed even in the rage of over 0.35 O.D.(^{18}F radioactivity was not corrected by counting efficiency of the gamma counter used in this experiment) (Fig. 2).

Discussion

The multiple label autoradiographic techinique using positron emitting radionuclide tracer has been proved useful for not only to demonstrate multiple physiological functions but also to evaluate basic properties of the new tracers for positron emission computed tomography.[2] However, among the unsolved problems of this new technique, one of the important factor before establishing the quantifying procedure is the standarization process of positron autoradiography.

There have been several trials for making the autoradiographic standards using the short half life radionuclides.[3,4] But it has been inevitable to make the standards in each experiments due to the very short half lives of the radionuclides. From the view points of this complexed procedure and also the simple radiophysical law of density-radioactivity relationship which autoradiographic technique essentially entails, we made the experiment to simplify the standarization step of positron autoradiography calibrated by commercially available ^{14}C standards.

The reproducible results of linear relationship between the ^{18}F radioactivity and the optical density under the same experimental condition - the same X-ray film, the same exposure time at the same temperature (exactly 21°C) and the same automatic developing machine - indicate that it is not necessary to make the standards of positron emitting radionuclide in each experiments for quantifying the regional radioactivity on autoradiography. Instead, it suggests that the quantifiable positron autoradiography can be underwent by simply using the ^{14}C standards if the experiment was performed under the scheduled condition. The standarization procedure of positron autoradiography which we have tried in this experiment will surely prove useful as a simple and reliable technique.

References

1) Kameyama M. and Ido T., Jap. J. Nucl. Med. 19 (1982) 1965.
2) Kameyama M., Ogawa A., Shirane R. et al., J. CBF Metabol. 3 (1983) S109.
3) Miles G., Niebuhr I. and Hossman K. A., Stroke 12 (1981) 581.
4) Sako K., Diksic M., Kato A. et al., J. CBF Metabol. 3 (1983) S99.

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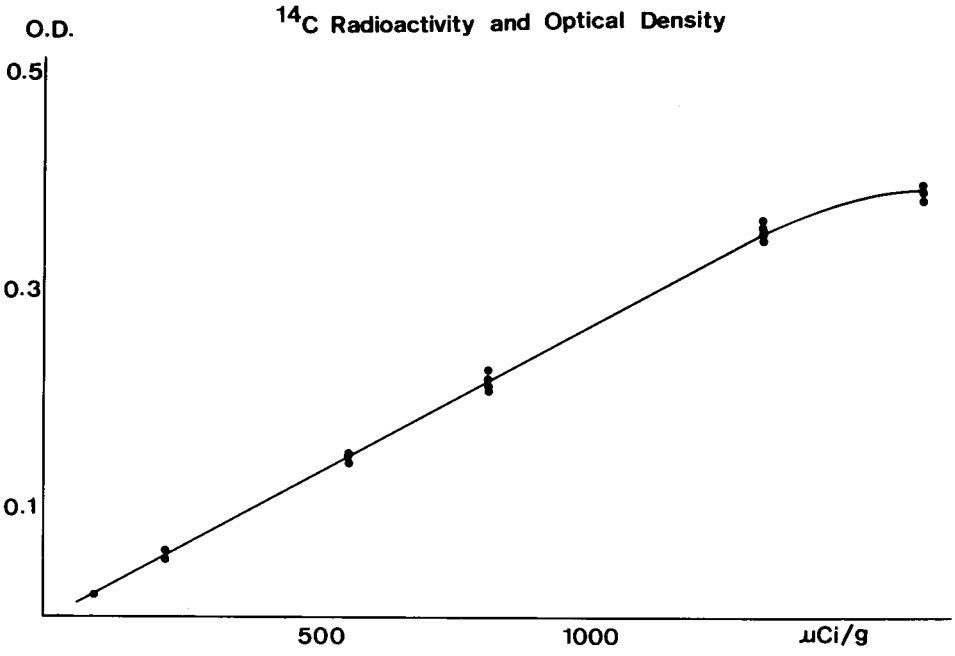

Fig. 1. Density-radioactivity relationship of ^{14}C standards.

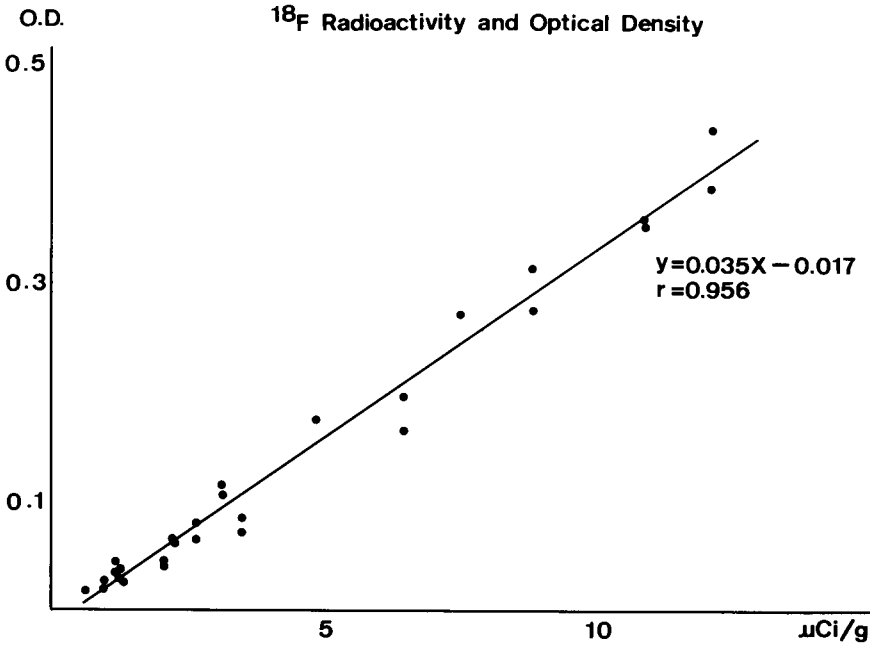

Fig. 2. Density-radioactivity relationship of ^{18}F.